The Physical Chemistry Library and Archive of Dr. Georg Bredig, Father of Catalytic Chemistry, Smuggled Out of Nazi Germany, Containing Original Photos, Rare Printed Materials, and Unpublished Correspondence

This archive, never before offered for sale, was acquired directly from the Bredig heirs
It is a snapshot of the golden age of science and math in pre-War Germany from the vantage point of one its primary participants.

The archive was shipped from Germany to the Netherlands just before the closure of borders and remained in the lab of Jacobus van’t Hoff in Amsterdam until after the war.

Rare printed materials, importance scientific correspondence and calculations, rare photographs, many oversized and signed.

In the late 1880s, a monumental change came to the world of chemistry, one that would have broad significance for our world today. This included the creation of complicated compounds like plastics, to power generators like batteries, a range of pharmaceuticals, and components of nuclear weapons.

Physical chemistry - the study of how matter behaves on a molecular and atomic level and how chemical reactions occur - dates from this period. This branch of chemistry dates from 1887, with Wilhelm Ostwald’s publication of Zeitschrift für Physicalische Chemie, a journal devoted to that subject. The leaders of the European school were Swede Svante Arrhenius, German Wilhelm Ostwald, and Dutchman Jacobus van’t Hoff. All three of these men would be awarded the Nobel Prize in Chemistry. Van’t Hoff and Arrhenius were 1st and 3rd, and the latter would be the first and long-time director of the Nobel Institute. They are giants in the scientific community, contemporaries of Albert Einstein and Max Planck. And in the midst of it all was Georg Bredig, one of the world’s first physical chemists, a German who worked with van’t Hoff in Amsterdam, Arrhenius in Stockholm, Einstein in Zurich, and Ostwald in Karlsruhe and Leipzig.

Fascinated by this branch of research, Bredig decided to move to the University of Leipzig in autumn 1889 where he learned from Ostwald and did his doctorate in 1894. After working at the laboratory of van't Hoff in Amsterdam for one year and thereafter in Paris with Berthelot and in Stockholm with Arrhenius, he became assistant to Ostwald in autumn 1895, in which capacity he was present for the opening of the first physical chemistry lab in the world in 1898 in Leipzig. In 1901 he was appointed as associate professor at University of Heidelberg where he was the first professor for physical chemistry. In 1910, he became a
professor in Zurich, where Einstein was working. From there, he received the directorship of his own lab at Karlsruhe, which was his last position.

In 1898, Bredig discovered that it was possible to make colloidal solutions of metals usable as catalysts and therefore has been called the founder of catalytic research. His work took place during a great flowering of math and science in Europe and Germany was, for a time, the hub. Arrhenius wrote the first paper ever on human impacts of climate change; Einstein authored his theories of Relativity; van’t Hoff and Ostwald paved the way for chemistry today and its applications to our way of life; Max Planck did much of his most prominent research. It was a golden age, and Bredig was witness to it all, and colleagues with the various players.

But Bredig was also a Jew in Germany in the 1930s. Beginning in the 1930s, the environment became outright hostile for Bredig and his family. In 1933, his whole world collapsed: his wife died and the German government forced him into retirement because he was Jewish. In 1937 his son fled the country. In 1938, he and his son-in-law were arrested during the notorious Kristalnacht, the latter spending weeks in Dachau before his release. Bredig’s money was seized and his gold and silver were taken; he was allowed to keep only his and his deceased wife’s wedding ring. He was banned from visiting public parks and going to the library, which was his second home. In 1939, Bredig fled Germany with fellow chemist and Jew, Ernst Cohen, writing a letter allowing him to come to the Netherlands. His daughter and son-in-law did not make it out in time. They spent more than a year in detention camps. Bredig’s son, Max, got him out of the Netherlands, and secured him a position at Princeton, where Einstein worked. Georg’s savior, Ernst Cohen, was not so lucky. He died in Auschwitz.

Meanwhile, Max began work to bring over other Jewish scientists and individuals who had known his father in Europe. He was mostly successful. One couple, who stayed because they felt it was their moral obligation, were shot and killed, forced to dig their own graves.

The story of Georg and Max Bredig is one of scholarship, science, advancement, and collegiality. But it also one of survival, tragedy, death, and heroism. The scope of Bredig’s life took him from the seat of scientific advancement and achievement, where he was accepted as an equal, to a desperate flight, his family detained, and saw him die far from home, deprived of his citizenship, sad and defeated. It is also a story of Georg’s son, who grew into his own saving his family and their colleagues and friends.

But the story of the salvation of his archive is also one of perseverance. Bredig early on recognized that the Nazi’s would destroy his library that he had built during his lifetime, a pride of his. His daughter shipped it to
the laboratory of van’t Hoff, where it was saved from the Germans throughout the Holocaust, and only after the war made its way to the United States, where the Bredigs now lived.

Provenance: This material, nearly all of the manuscript material unpublished, was acquired from Bredig’s direct descendants and has never been on the market before.
The Unpublished Correspondence of Nobel Prize Winner and Nobel Institute Head Svante Arrhenius

More than 80 lengthy letters on the dawn of the Nobel Institute (he was the first and longtime head of the Institute, climate change (he was the first to study its change at the hands of humans), chemistry (he was the third Chemistry winner of the Nobel), politics

Containing not only text but also scientific equations
Svante Arrhenius was also one of the founders of the field of physical chemistry, and one of the preeminent scientists of his era. He had the additional credentials of being present at the beginning of the Nobel Institute, serving as its first director. He won the Nobel Prize for Chemistry, its third recipient, "in recognition of the extraordinary services he has rendered to the advancement of chemistry by his electrolytic theory of dissociation." He was the first person to study the effects of human activity on climate change.

Beginning in 1890, Arrhenius wrote to his colleague, Georg Bredig, the founder of catalytic chemistry, on subjects that range from chemical reactions with equations, the essence of his Nobel Institute work as first Director, the work of van't Hoff and Ostwaldt, among others, climate study, the disassociation of salts, and much else. Along with the van't Hoff letters, these show the founders of physical chemistry working hard on the foundations of what we use today in chemistry.

The archive:

- More than 80 mostly lengthy letters of Arrhenius to Bredig, in German and generally unknown and unpublished until now. The below represents a miniscule percentage of this large archive.

Where letters have been quoted, in most cases, the quotes are very small excerpts from much longer letters. The letters cover, along with the above:
- Science and scientists of the day
- The nature and fundamental elements of chemistry and physical chemistry
- Contemporary scientists and their work / publications
- Arrhenius’s work on salts, solutions, climate change, the northern lights, and other areas
- World War I and hardship for scientists
- Nobel Prize awards, the founding of the Prize, and his stewardship of the institute
- Much more

Excerpts, presented more or less chronologically:
The disassociation of various ionic compounds, something at the heart of physical chemistry. These can be used in calculations to predict the behavior of chemical reactions, likelihood of reactions occurring, etc.

Autograph letter signed, July 7, 1890.

Dear Doctor,

I am very grateful to you for informing me of the results of calculation, otherwise unfortunate misunderstandings could have arisen. I had previously observed that the values in table D and table E in the article cited diverge a little from those that were calculated from formula 3. This stems from two facts: first, there stands in formula (3) \( \log_v 10 = 2.35 \) instead of \( = 2.30 \) and this explains the largest part of the differences between your calculation and mine. Second, there are small differences that arose from the fact that I did not calculate table D and E by means of formula (3), but rather with another, older one which was later transformed into (3) and this somewhat different treatment of the observation material explains the small differences that still exist. I admit, it would have been more correct (because of the regularity) to convert the numbers with formula (3) (2.35 corrected to 2.30). I refrained however from doing so since the differences between the two ways of calculating are relatively insignificant, and in any case lack any practical significance. W35 could in no way demand an accuracy of 110 cal. for the dissociated bodies, as I noted directly (J. 1062.8). The most correct thing would have been to avoid using not only the last number but also the next to last with the value of W35. Since I am responsible for this misunderstanding, I recalculate W35 in table E based on the corrected formula (3) (compare Zeit. phys. Ch. V, 3 Note). I obtained the following values:

<table>
<thead>
<tr>
<th>K Br.</th>
<th>KJ</th>
<th>KiI</th>
<th>KNO3</th>
<th>NaCl</th>
<th>LiCl</th>
<th>( \frac{1}{2} )BaCl2</th>
<th>( \frac{1}{2} )AgCl2</th>
<th>( \frac{1}{2} )AcSO4</th>
</tr>
</thead>
<tbody>
<tr>
<td>+176</td>
<td>-317</td>
<td>+237</td>
<td>+463</td>
<td>+145</td>
<td>+200</td>
<td>+292</td>
<td>-92</td>
<td>-967</td>
</tr>
<tr>
<td>+504</td>
<td>+208</td>
<td>+695</td>
<td>+1146</td>
<td>+1121</td>
<td>-218</td>
<td>+405</td>
<td>+213</td>
<td>-481</td>
</tr>
<tr>
<td>HNO4</td>
<td>Hvr</td>
<td>NaOH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-765</td>
<td>-1019</td>
<td>-706</td>
<td></td>
<td></td>
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</table>

I repeat however that the last two numbers are not significant. In addition, one can calculate from the well-regarded numbers of Kohlrausch W22. He conducted his measurements at 18 degrees C and 26 degrees C (normal solutions for 0.01).
As far as your calculations are concerned, they are quite correct if 2.30 is used instead of 2.35.

If you would like further explanations, I would be happy to oblige. In about three weeks, I will be staying in Leipzig for a few days and that will be a good opportunity to discuss the matter further.

Your devoted,

Svante Arrhenius

The work of Ostwald, considered a father of physical chemistry, about the disassociation of ionic compounds (“salts”) and using that information to calculate the conductivity of solutions formed from them.

Autograph letter signed, November 28, 1891

Your message from November 23rd greatly pleased me, I was really expecting, in accordance with Lehmann’s determination of the strength of bases, that water has a conductivity that approximates the conductivity that Lehmann directly determined. But based on my calculation, the specific conductivity of water that was calculated from your data (at 25 degrees?) not 2.10 \( -10 \) but rather approximately 0.310-10, that, somewhat smaller than Kohlrausch’s value which was to be expected a priori. It is determined as follows:

\[
A \quad B
\]

<table>
<thead>
<tr>
<th>Quantity, dis. Water</th>
<th>Quantity dis. Mol.</th>
<th>Quantity non-dis. H2O (=1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per liter</td>
<td>Per liter</td>
<td>Per liter</td>
</tr>
</tbody>
</table>

The quantity of water is calculated in liters (not grams?). If no other dissociated bodies are present, then \( A=B \) will consequently be the quantity of dissociated H\(_2\)O molecules in a liter of water \( A=\sqrt{K_4} \). Based on your measurements, \( K_4 \) is 11.10-9 \( \frac{1}{28500} = 40 \times 10^{-14}, \) thus \( A=6.3 \times 10^{-7} \). Since the molecular conductivity at 25 degrees of H and OH is each approximately (320+170)10-7 the specific conductivity ability of pure water at 25 degrees(?) will be \( A=6.3 \times 10^{-7} \times 490 \times 10^{-7} = 0.3087 \times 10^{-10}. \) (0.31.10-10)
Now, $A$ is probably significantly greater at 15 degrees than $A$ at 18 degrees which means the number determined by Kohlrausch 1.10-10, if I remember correctly. Kohlrausch thus found a number that was somewhat too large, which is highly probable.

Actually, when correcting the conductivity of aniline, one should of course carry out a rather complicated equation for the conductivity of water, similar to the manner of calculating isohydric solutions. But to that end it would be necessary to know precisely the conducting components of water (carbonic acid, ammonia carbonate) which is unfortunately not the case. One must therefore settle for an approximation. If the specific conductivity of the solution is very small, that is, if it very close to the conductivity of the water that was used to dilute the solution, which is probably true of the case at hand, simple subtraction of the conductivity of the water will yield better results. This does not however have to be the case if the conductivity of the solution is relatively great, rather it is entirely a matter of how the adulterated water that reacts to dissolved bodies. D. Berthelot states that he found for ammonia whose solutions conduct much better than those of aniline, there is no correction—because of the conductivity of water— that yields better results. (K then turns out constant.) Applying the simple correction would lead to almost correct results even this case, if the adulteration of water were a salt such as NaCl or something similar. This does not appear to be the case.

Of course, it is best if you include these numbers in your publication because although the editing of this chapter promises extremely interesting results, it is impossible to know when these results can be included again. And it would be completely wrong to bury these numbers for an indeterminate time.

Many thanks for the kind message and greetings to you, Prof. Ostwald, Dr. Wagner and Dr. LeBlanc.

Autograph letter signed, November 18, 1893.

I was pleased to receive your letter from November 7th since I gather from it that someone besides me is working on the Lellmann story. Naturally the matter is very complicated, but I think that one may disregard the disturbances that you have noted—they would be hard to calculate and if one can calculate the helianthin salts exactly, as we calculated aniline acetate. I therefore wrote to Lellmann to request some complementary numbers, but I have not received them in spite of waiting for three months. When I received your letter, I gained a new perspective on the matter and did the calculation without the numbers that I had demanded. That works too, you only have to derive a few more constants from the experiments themselves. Lellmann’s numbers work out to be exactly what the theory of simple hydrology demands. To make this clear to you, I’m giving you the numbers that I calculated. The observed numbers are underlined.

0.1125 mg in aqueous sol.He(?)+ 40mg in aq. Sol. Acid 10mg 2.5ns(?)

0.625

Chloroacetic acid (observed) 1.08 1.20 1.37
Acetic acid  (calculated)  1.0v  1.06  1.09

acetic acid  (obs.)  1.12  1.25  1.40
butyric acid(?)  (cal.)  1.16  1.28  1.44
butyric acid(?)  (obs.)  1.12  1.23  1.32
chloroacetic acid  (cal.)  1.08  1.16  1.28
chloroacetic acid  (obs.)  1.08  1.11  1.16
trichloroacetic acid(cal.)  1.05  1.07  1.09

The deviations (the largest were in chloroacetic acid) by salt formation (for example, through poor glass vessels) in rather small quantities.

I am taking the liberty of asking that you inform Prof. Ostwald of these results when you have the chance. They will undoubtedly please him. I will send him a short report about these calculations for the journal about these calculations.

Mr. Farjug (?) writes that you might come for a longer visit here. It would of course be an extraordinary pleasure, to welcome you for a short or, even better, for a longer time.

I am concluding now with warm greetings to my many dear colleagues in Leipzig, especially Wagner, Le Blanc and above all Ostwald.

Best regards and wishes for a pleasant reunion (I am coming for the summer to Leipzig.)

Climate change and his work on “Carbonic Acid”

In 1895, Arrhenius presented a paper to the Stockholm Physical Society titled, “On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground.” This article described an energy budget model that considered the radiative effects of carbon dioxide (carboxylic acid) and water vapor on the surface temperature of the Earth, and variations in atmospheric carbon dioxide concentrations. Arrhenius argued that variations in trace constituents—namely carbon dioxide, which he called carbonic acid—of the atmosphere could greatly influence the heat budget of the Earth. Using the best data available to him, he performed a series of calculations on the temperature
effects of increasing and decreasing amounts of carbon dioxide in the Earth's atmosphere. These are considered the first studies in climate science as we know it today.

**Autograph letter signed, November 15, 1895.**

I am still working on carbonic acid .... The carbonic acid must be finished by December 11th, hopefully the “temperature of the moon” will be finished too.

**Autograph letter signed, January 3, 1896**

By December 11th I had completed enough of my endless work on carbonic acid that I was able to deliver it to the Academy for the meeting that was held then. Two long papers that are being published in Bihang or Handingas, are supposed to be evaluated by specialists in the field. During that time, one can make small improvements and I did that and I wrote an appendix that contains observations of moisture. That took about fourteen days. …

**The Nobel Prize and Institute**

On December 10, 1896, Alfred Nobel died and his will stipulated that his fortune was to be used for Prizes in Physics, Chemistry, Physiology or Medicine, Literature and Peace. Arrhenius, who was a Swedish scientist, was on the front lines. Arrhenius was not only an early Nobel Prize recipient; he was on the committee to select winners and also the head of the institute for decades, its first head. There are many letters that relate to Nobel, the Institute and his work there.

**Autograph letter signed, Jan. 2, 1896.**

I have learned that the great Nobel fortune will go to a fund; scientific work from the entire world is supposed to be supported from the interest.

Often his letters touch not only on his climate research but also on natural elements in the North and a few scientific expeditions.

**Autograph letter signed, July 22, 1896**

There are a lot of animals, my travel companions did a lot of hunting. Even three polar bears were put down by passengers of the "Virgo." In addition, there are seals and birds that were put down during the hunt. There are so
many sea birds on the small islands that one can stroll around as if one were in a chicken yard and shoot. You could almost catch them with your hands.

Within a week the balloon will probably go since all of the preparations are complete now and it will be filled with hydrogen. After that they will have to wait for favorable winds. Then it will take about twelve days before we are in Gothenburg and on the way home I will have to do most of my work. I will probably stay for a week in Gothenburg before I return to work in Stockholm.

On the opening of the Leipzig Institute, the first physical chemistry lab, under the direction of Wilhelm Ostwald, and further calculations of climate change

Autograph letter signed, October 28, 1896.

I am glad that your institute will soon be finished. I would like to come for the opening, but I cannot predict that far in advance whether it will be possible for me to come. I am extremely glad that Ostwald is doing so well and especially that he is tinkering around in the laboratory. I will soon compile the speed of dissolution. Until now, I had to do various other small projects. I still have more to do for my work with carbonic acid, I am reading corrections in the paper published by the academy here. By the way, in the English edition, I did not consider a fact that doubled the effect.

Kinetics and the work of Ostwald

Autograph letter signed, December 29, 1896.

Recently I received the first issue of the third book of Ostwald’s great work and I leafed through it. I can clearly be very satisfied with it. But why is there this eternal dispute with kinetics? Hasn’t kinetics helped us make discoveries that later receive unimpeachable proof from mechanical thermal theory, thus it is to the great credit of kinetics that it served as a trailblazer. Energetics certainly never accomplished that. In this case, one has to apply the old adage “live and let live.” The entire theory of electrolysis is absolutely kinetic and energetics would not be able to help us much at all.

Studying the Northern Lights

Autograph letter signed, March 19, 1897
I’ve so little time to spare not because of the presidency, but rather because of my work on the Northern Lights with Ekholm. We collected 34,000 Northern Lights and tabulated them according to direction and corrected them. If one wants to make headway with material of this kind, one must apply all of one’s energy and take advantage of every free hour. Fortunately, most of the work is only mechanical, something like crocheting socks, otherwise one would wear oneself out. I have felt the effects on my waistline…. I found what we were looking for with the Northern Light, namely that the moon strongly promotes the Northern Lights everywhere and at all time if it is in the southern sky. The reverse is true if the moon in the northern sky. Now we are examining the influence of the rotation of the sun. It seems doubtful that we will find any influence, Liznar would then be wrong. In April I will probably work on reaction velocity.

Andrée’s Arctic balloon expedition of 1897 was an effort to reach the North Pole in which all three expedition members perished. S. A. Andrée, the first Swedish balloonist, proposed a voyage by hydrogen balloon from Svalbard to either Russia or Canada, which was to pass, with luck, straight over the North Pole on the way. The scheme was received with patriotic enthusiasm in Sweden, a northern nation that had fallen behind in the race for the North Pole.

Autograph letter signed, July 21, 1897.

There is naturally a lot of discussion here about how the three Polar explorers are doing. The expedition might last a month or perhaps even longer. Maybe they are stuck right now in a snow storm near the North Pole and will not be able to get farther for some time. A situation of this sort has to be unpleasant….

…The university recently received 100,000 crowns from General Consul J. W. Smith(?) as a donation. This will greatly help since the university had not had a donation for a really long time. The returns from the donation are supposed to go to stipends and support for our scientific projects. Only the gods know how things will go with the Nobel legates.

Ostwald’s law and the formulation of the Nobel model

Autograph letter signed, December 11, 1898.
Apropos science, you asked whether the paper that stems from the principle that ions are removed from one another, might not make the deviation from Ostwald’s law plausible. I hope that you have recently spoken to Dr. Euler; he is familiar with my views on the deviation question that I’ve been tormenting myself with for years. An ion in the interior of the liquid is not driven to a side, therefore there would not be an equilibrium if one then removes the other electrically attracted ions. No project is completed this way, as far as I can see. The complicating factor is of course that the deviation is not dependent on the ion concentration: compare phosphoric acid that is only slightly dissociated with di- and trichloroacetic acid which though considerably dissociated, nearly follows the law of dilution. I am working on half physiological topics which displeases many electrochemists (for example Nernst), but of course it is impossible to be absolutely proper. You have the Jablowowski Foundation in Leipzig that awards prizes, I would be grateful if you could acquire the statutes for me. I am now collecting statutes of that sort for the Nobel Foundation whose statutes are being worked out. Give my greetings to all of my dear friends at the institute.

P.S. What are the statutes of the Jablowowski Foundation like that announce big prizes? If you could get them for me, I would be very grateful to you. I am collecting everything that can be used as a model for the Nobel Foundation that is supposed to be founded soon. Finkelstein came back the day before yesterday. He is a good person and says hello.

Nobel work and Ostwald’s law of dilution

Autograph letter signed, Stockholm, January 20, 1900.

Naturally, Nernst’s law of solubility breaks down, but if Ostwald’s simple law of dilution does not apply to salts in a homogeneous solution and all agree about that, how could it suddenly come into play through the fact that one of the components of the equilibrium occurs in excess in the precipitate… Here in Stockholm, it is awful that a great deal of administrative work concerning scientific institutes will be done. That will demand a lot of my time but what can one do- one is a function of one’s surroundings and one cannot look on while refraining from participation as matters are concluded unsatisfactorily.

A scientific dispute with Nernst re: acids

Autograph letter signed, July 12, 1901.
I hope to come to the conference of natural scientists in Hamburg this year. It is not only the discussion of ions that entices me, but also the discussion about serotherapy. I am working on that with Madsen, but we haven’t gotten very far yet, things are quite complicated and the effects change so greatly with the temperature.

As far as my quarrel with Jahn and Nernst is concerned, the general opinion seems to be that N. behaved in a very inhumane way. But Ostwald compelled him to delete the most uncivil comments. I was rather afraid that N. would take exception to the fact that Helmholtz’s deduction was preferred to his. By citing Nernst’s own words in this delicate matter, I made an effort to assert only that which N. himself had asserted. His deduction in Wied. Anm. is highly deficient; he does not say with which conditions he is working. In general N. acts as though the laws of dilution for salt solutions were strictly valid. He only says, it is probably that \( \mu_u = \mu_\infty (?) \) does not give a correct measure for the degree of dissociation. This probability rests on fact that one can apply the laws of dilution to these values. I am convinced that for great dilutions, \( \mu_u = \mu_\infty \) gives completely correct values of dissociation. Why should it be different than it is for acids? This is certainly an empirical fact and I do not believe that Nernst’s theoretical considerations can change the state of affairs in a significant way. The measurements with electromotive forces can yield nothing but freezing point measurements and it seems to me that these measurements can be taken more precisely. The experiments with the freezing point with respect to salt solutions tallies nicely with the values calculated from \( \mu_u = \mu_\infty \). This is an empirical fact that can only be challenged with new measurements, but not with new theoretical considerations. It was a shame that I didn’t have time to examine Jahn’s deduction thoroughly before I traveled to Copenhagen. J. hopes for everything from this new law. I think I will have a lot of difficulties with that. In any case he has a new constant now that he can determine through experimenting. Then of course the new formula has to be more accurate than the old one.

In any case, the big attack from Jahn about which he made such a hue and cry, had little tangible success. Naturally, Jahn and Nernst will continue to work to discredit the formula \( \mu_u = \mu_\infty \), since they have fallen in love with their idea. Nevertheless, the discussion will be interesting.

Taking over the Nobel Institute

Autograph letter signed, March 29 1905

Here everything is proceeding as usual. It has been decided that the new Nobel Institute for Physical Chemistry will be opened on October 1, 1909. In the first year we will make do with temporary facility, perhaps in the same building where I live. There, only those projects can be conducted that require only modest means. Next year I will presumably work on the formulation of my views concerning the bonding of toxin and antitoxin and related problems. After a year I will move into an excellent place, that of the current Navigation School. It has a floor space of
300 square meters. One floor will be for the new institute, a second one for the institutional apartment, the secretary’s office and the conference room of the national committee and some room on the top floor will be for the custodian and the assistant. I will set everything up as well as possible so that I can stay there during the rest of my work time.

The nature of chemistry and physical chemistry, Ehrlich

*Autograph letter signed*, January 1, 1908.

I think that you give too much credit to the obscurantists who assert that the chemistry of living beings is fundamentally different from the usual kind of chemistry. As Buchner himself said in a talk here: “There was (in the second half of the 19th century) no chemist who did not think that the fermentation fungi had a chemical effect through the content of enzymes.” This question has always been answered by chemists in one sense. But if a few physicians have a different view, we should not concern ourselves much about that, they have all kinds of strange ideas.

We can see what all Ehrlich asserted and be is considered in those circles as a sophisticated chemist. Those people have not been trained in the exact sciences, what should one demand-geniuses who unconsciously make correct judgments. They can’t all be geniuses.

Bunsen, Haber and Nernst

*Autograph letter signed*, July 21, 1908

I want to thank you for the kind invitation to come over to the dedication of the Bunsen memorial. I would have liked to have done that if it had been possible for my wife and me. Indeed, I hold Bunsen in the highest esteem as a scientist in all fields and as a congenial person.…

… I am quite pleased with the dignified reply that Haber gave to Nernst in response to the wanton attack at the assembly of electrochemists. After Wartenberg’s spectacular failure and Johnston’s measurements that were made with the best intentions there will not be much more left of Nernst’s main theorem than of Berthelot’s. I do not begrudge that to Nernst because I know how he tried to discredit my scientific work with every friend of mine who visited him in Berlin. And he tries to do that with everyone who appears to him to aim too high. And of course, I was the one who introduced him to physical chemistry and who gave him insight into my ideas that have benefitted him greatly. But as soon as he thought he could stand on his own, he did everything to take me down. That was one of the few sad experiences in my life.
Einstein

Autograph letter signed, September 6, 1908

It is very pleasant here. There were no official ceremonies before I left. That is the stupid thing in Sweden: as soon as people are together, horribly expensive banquets have to be arranged. It is the same in England: I hardly know how I can eat my way through the conference. But the best thing of all is that I will interact with Ostwald every day. He will return to atomic physics- he is still hesitating a little bit. The Brownian movement prompted him to return. Very peculiar, this movement has been known since 1826 and has been discussed quite a bit. But through the work of those doing research on colloids such as Svedberg and Einstein, it has become familiar to Wolfgang O. and Will. O. is also writing on the fourth volume of his textbook on colloids. So, something good has come out of colloid chemistry after all.

Nobel Nomination of Oswald

Autograph letter signed, January 21, 1909.

I suspect that the Russians will nominate Ostwald. It could be that if enough factions join in supporting him. a favorable outcome for Ostwald could be expected. In any case you can go ahead and nominate Ostwald and add that in the event that his great accomplishments in the view of the Academy do not fulfill the statutes of the Nobel Foundation, you will recommend another candidate with more recent contributions, for example, Willstätter. I mention him because I assume that he will be nominated by another distinguished person.

Publications

Autograph letter signed, March 10, 1909, Arrhenius to Bredig

I have been working for a long time on the galleys: I am finishing at least one new edition of the Theory of Chemistry. And new, foreign language editions of Worlds in the Making and its historical sequel are continually appearing and thus I have to look through and improve them so that the meaning of the original will not be badly distorted. The time will soon come for immunochemistry and electrochemistry. In addition, there is a short polemic on carbonic acid that awaits completion.
The functioning of the finances of the Nobel Institute, salts and acids, Planck and energy quanta

Autograph letter signed, March 22, 1912 Arrhenius to Bredig – nobel, planck

I congratulate you on your new laboratory. Unfortunately, Nobel only thought of scientific works in terms of awarding prizes. Only a compromise with the heirs made the establishment of Nobel institutes possible but they are being set up very slowly because the money is coming in slowly. If a prize is not awarded because of the lack of suitable candidates, the funds can be used to support experimental projects.

What you are telling me about Prof. Snethlage's work greatly interests me. The view that the sequence of acids can remain the same with relation to its degree of dissociation in various solutions does not, as far as I remember, tally with Godlewski's investigations. I've been looking at his paper/book from the Academie d. Sc. De Cracovie 1904, p. 253 and think that in C2H5OH the sequence is: cyanocetic acid (1), O- phthalate (2) part of word missing (3) bromoacetic acid (4) O- nitrobenzoic acid (5) Chloroacetic acid whereas in water the sequence is 5, 1, 3, 6, 4, 2. That was surprising for me because I had found the same sequence for salt solutions, only more distinctly. Godlewski did not start from a preconceived notion. The view that Snethlage (word missing?) to explain the salt effect is in any case quite interesting. One will however encounter difficulties if one wants to expand his view to saponification through bases. Naturally I will gladly look through his manuscript and will be very careful with it so that his ideas will not become known before he would like.

The theories of energy quanta are extremely appealing, but it is hard to follow along especially since Planck frequently makes changes and expresses his doubts about his earlier views. Before the question has been uniformly worked through, one cannot say bow far the current hypotheses are feasible or in need of improvement. The experiments with electron emissions in chemical processes are very interesting and I eagerly anticipate their continuation. I find it smart that you chose photochemistry and physics as your field of work, the reactions in this area are of the highest practical and especially biological significance. Euler and his students are doing a lot of work on that too.

The heyday of science, Einstein and Planck

Autograph letter signed, January 1, 1913

As far as the mathematical heyday under Planck, Einstein and others is concerned, I am adopting a skeptical attitude. Next to Lorentz, Planck is the most sophisticated and I have great respect for his achievements. I can remember quite well the time in which he helped us and where he played a useful role because the opponents
superstitiously had the mathematical fetish. He only half understood what the question was and when he clothed van 't Hoff’s idea and mine in half-transparent mathematical garb, he laid claim to priority that I had to drive him away from with a bit of gentle force. He first substantiated Wien’s formula as long as it was seen as correct, but when Rubens and Pringsheim found that another formula is better, he substantiated it with the help of “the next most viable hypothesis.” Now he is changing almost continuously his opinion about the interesting quantum question just as Einstein did with the relativity question. Mathematics is complicated for most people and creates all kinds of illusory results when used carelessly. Thus, I am waiting for something to be put out as somewhat reliable by mathematical physicists.

War

Autograph letter signed, December 18, 1914.
That is the immoral thing about war and I hope that an agreement will be reached to abolish this primitive way of making decisions and to replace it with a court of arbitration. One would give up some sovereignty and medieval honor but would gain an unprecedented degree of civilization. To replace our culture that is now being driven back, one should abandon armaments except for a kind of police force. Perhaps some of these hopes will be realized when peace is concluded.

The Schutz Rule

Autograph letter signed, July 3, 1918 From Arrhenius to Bredig
Thank you for your nice letter of June 19th which arrived a few days ago. The regularity is called the Schütz rule: the converted quantity is proportional to the square root the effective enzymes and to the square of the action time (as much as half of the substrate is converted.) The experiment on p. 9 shows that the converted quantity is proportional to \( \sqrt{T} \). The experiment on p. 10, according to which \( F(x) \) is just as proportional to \( V \) as it is to \( T \) shows that the percentage of the conversion of NH3 is also proportional to \( \sqrt{V} \). The absolute conversion is in the case of concentration \( T \) proportional to concentration \( C \), thus proportional to \( C\sqrt{V} = \sqrt{C} \), since \( C = \frac{1}{V} \) where \( C \) is the concentration of NH3 (or of the enzyme). On p. 11 I prove through an experiment that \( F(x) \) with \( P \) is proportional to the concentration of the ester.

Recovery from war
Autograph letter signed, September 23, 1918 Arrhenius to Bredig

At the same time, one cannot refrain from hoping that good times return, that the painful struggles of humanity and the anxieties for the future will not devour all of our thoughts to the point that the energy for the work to which one has dedicated his life, is dammed up. I wish you from the bottom of my heart success with your work- you have earned it.

Science after the war

Autograph letter signed, January 11, 1919

I was glad to receive your New Year’s letter. I also received a letter from Ostwald, the first since 1914. He writes that he answered all of my letters. The censor intercepted them. Typical of the old government. And only and shrinking number of people voiced criticism about that. That’s why Germany had to suffer so much and will continue to suffer terribly. The hatred of Germany is unbelievably strong in France and England. The conditions of the ceasefire were horribly harsh. You ask why one is protesting against that. What good would that be? In the foreseeable future there won’t be a new ceasefire in which one will be able to heed a warning. Nobody protested against the peace of Brest-Litovsk and Bucharest. The unfortunate consequences of these treaties are already evident for Germany and the entire world. You once asked me why I did not protest against the bombing of Karlsruhe: because the Germans started this terrible traffic in bombing England and France. In fact, one should have protested against the declaration of war, because there is no greater crime than a war. But that of course would not have helped, there was no chance of that.

Now the Kaiser can see that be committed the worst crime in history. And Germany, which was one of the top producers of armaments, has to suffer terribly for that. Let’s hope that the others are more reasonable and commit to a general disarmament. We have to put our hopes in Wilson. In general, it is Europe that lost this war that has shown how hollow European culture was. The German people were deceived by their leaders. But travelers to Germany told me about the enthusiasm of Germans when the war broke out. Unfortunately, they wanted the war. And now the terrible unrest. It only makes the misery worse. Fortunately, it now appears that order has been restored.

What is happening now with the German university in Prague? I heard that it is supposed to be moved to Salzburg. I am very curious because of Rothmund. The Austrians will nevertheless fail to rise again if they do not give up its territories in Italy. I am glad to hear that the Germans are working so diligently. Is that true of the lower classes? As soon as things calm down, I will probably visit Germany and Austria again to see how my friends are doing. I am very concerned about scientific work there, because in the miserable financial situation it will be hard to keep universities at a high level. In the next five years it will an interesting time for judging the future. What will become of poor Russia on
which Germany unleashed Lenin? But with its natural resources Russia has the means to recover quickly if it is reasonably governed.

Scientific Associations

**Autograph letter signed**, March 26, 1920.

Things have the same for me as for you. There have been so many associations formed to promote better relations between peoples, others to improve and reorient our economic relations and also new scientific associations. In many of these I am a director or member of the board. Things are difficult with the physicists, they are quite divided. Sommerfeld and Baker are now working against one another. We have obtained and engineering academy here that receives a lot of money from the state to investigate practical matters whereas the state has control over our academy (the Nobel Foundation). Thus the Academy of Sciences is languishing. I hope that our connection with the International Research Committee will bring about an improvement of the situation. I congratulate you for receiving the honorary doctorate in Rostock – I got one in Greifswald. You have certainly earned it. We now have a socialist government under Branting during the war it was said that this would trigger a war with Germany- now nobody is worried about that. The Socialists will probably not stay in office long.

**Nobel after the war**

Autograph letter signed, February 26, 1921 Arrhenius to Bredig (2 pages)

As far as the institute is concerned, the war years were quite bad because all of the non-Swedes had to leave. The costs of heating and materials rose drastically, which meant that the reduced activity was economically viable. The hopes for the future are not very strong. The cost of living has risen enormously and because of the severe depression that we are now enduring, young people are prevented from enjoying a luxury such as doing scientific work without the prospect of remuneration. The world has truly gone off the rails.

**Germany after the war**

Autograph letter signed, March 1, 1922

When I traveled to Germany in June of last year and stayed in Berlin, I paid a visit to Nernst. I was so sorry for him because he lost his two sons in the war.

…I had the strong impression of the difficulties that Germany is suffering from and will continue to suffer for many years. The economy is completely devastated because of the low value of the Reichsmark and without an increase in value the general misery will continue. But if the value increases, especially if that happens quickly, industry will be
crippled and prices will rise rapidly. We are going through this unpleasant phase as are those countries whose exchange rate has maintained.

Here in the laboratory it is very quiet. No one has money for training or for the pursuit of ideal purposes. I will go to France, Belgium and Holland at the end of this month to see my old friends. They will probably demand that I give a few talks. I have to prepare them thoroughly and not until I return at the beginning of May will I be able to do some work.

Autograph letter signed, June 16, 1924. Arrhenius to Bredig sciences in germany

I knew that things are quite difficult for the sciences and scientists in Germany. In spite of that, research is badly needed, to judge by the large number of article that have recently appeared. I therefore thought that the government is strongly supporting universities and other research organizations and I also heard some statements that supported that belief. Later I found out that the government’s promises were not being kept, probably because of the absolute lack of funds. Now I see from Schreiber’s book that the situation is even more desperate than I could have ever imagined. This summer I saw a couple of doctors who were working in a paper factory in Örebro and who look strong and well-nourished although they came from Germany where many are going hungry. Hopefully their earnings are not being devoured by the exchange rate. With Austria it was possible to alleviate suffering somewhat through alms. But now the cost of living in Germany is as high as it is in Sweden, it is not possible to collect adequate means to organize something meaningful for the German nation- earlier we had collections of 10 Swedish crowns per month which was enough for the needs of a student. The rest of the world too will be badly affected by the hardship of German research.
The Unpublished Correspondence of the First Nobel Prize Winner in Chemistry, Van’t Hoff, Written to His Colleague Georg Bredig

*Letters and pages of calculations covering chemistry and its development into physical chemistry*
Jacobus Van’t Hof was born in the Netherlands and was the very first awardee of the Nobel Prize in Chemistry. His work began in the 1870s but it was not until the 1880s that he was recognized, at which time he did some of his most prolific work. He and German chemist Wilhelm Ostwald founded an influential scientific magazine named Zeitschrift für physikalische Chemie ("Journal of Physical Chemistry"). He worked on Svante Arrhenius's theory of the dissociation of electrolytes and in 1889 provided physical justification for the Arrhenius equation.

George Bredig worked in van’t Hoff’s lab in Amsterdam and the two maintained a correspondence. They worked together on research relating to the laws of thermodynamics and the behavior of dilute solutions and gases. Their correspondence shows the progress of science in the early days of physical chemistry, when scientists were attempting to understand the energy released in reactions, how quickly reactions proceed, and how reactions change when temperature is changed.

The van’t Hoff equation, which he created and still bears his name, describes how the rate of a chemical reaction (“K”) varies with temperature. K itself typically depends on the concentrations of chemicals in a chemical reaction, denoted by [chemical name] or C[chemical name]. By manipulating the van’t Hoff equation, it’s possible to calculate the heat involved in a process at a given temperature, or the likelihood that a reaction will occur.

There are approximately 21 letters and cards of van’t Hoff, 5 of Bredig to van’t Hoff in draft form, and 12 large sheets of paper with extensive calculations in his hand, totaling around 40 piece total, evidently unpublished. The letters and calculations relate to some of the more important work done by the earliest generation of physical chemists. This includes: solutions, solvents, centrifugal force, hydrogen pressure, temperature affinity, etc…

Excerpted summaries of the letters, all of which are written by van’t Hoff in old German script. Includes a handful of draft letters of Bredig to van’t Hoff from the same period.

Pages of equations (12 in total, extensive, detailed equations in the hand of van’t Hoff)
One page of equations, excerpted:
Manuscript, scientific notations in the hand of Van’t Hoff. Here Van’t Hoff studies the dissolution of salts PbCl2 and KBr in water to form PbBr2 and KCl. Arrhenius, van ’t Hoff, and others are well known for laying the foundations of understanding such phenomena. The chemical reaction is associated with a change in its free energy (“Arbeit”, A). This document contains a direct application of the van ’t Hoff equation in a slightly modified form, and the use of free energy is somewhat noteworthy also since it was only introduced ~12 years prior. This concept is throughout all of physics and chemistry today and considered foundational.

Three related pages of notations, 2 by Van’t Hoff and one by Bredig:

These show a calculation of dE/dT for the dissolution of NaSO4 in water. This quantity is how the energy of the system increases or decreases as temperature is changed and commonly referred to as the “heat capacity”. It is calculated in this letter as E - W (work)/T. What is noteworthy here is the application of the First Law of Thermodynamics by van ’t Hoff, which is a fundamental law of physics and which was only fully stated in 1850. In document 11, Bredig continues the calculation and directly applies the van’t Hoff equation (d ln C/dT = A/T^2) to assist in the calculation of the quantity. You can see in the sketch Bredig attempting to calculate dE/dT geometrically from the plot.

Excerpts from the letters:

**Autograph letter signed**, December 20, 1894, Amsterdam. “A decisive experiment, which maybe you should try, is to test the probability of distillation for a solution in molecules with different liquids, such as TCM3 and H2O. This centrifugal force then almost has to turn into TCM, the temperature difference for both in calculable amounts.…."

**Autograph letter signed**, June 23, 1900, Charlottenburg: “A while ago Julius Wagner told me about your plan to propose the extension of the field of activity for the D.P.G. (Deutsche Physikalische Gesellschaft/German Physical Society), and also in the sense of the truly generally perceived physical chemistry. I will support this proposal, as long as a solution is chosen that ensures us the collaboration with the organic chemistry. Would it be possible to prepare something about this topic for the conference in Zürich?"
Autograph letter signed, June 30, 1900: “Thank you very much for your letter; now I had time to think more about it. I have to admit that your plan seems too idealistic in my eyes in order to be implemented in its entirety, however, a step ahead could perhaps be taken successfully by developing those aspects of physical chemistry further that are or presumably will become important for physics. I would happily embrace this step, and have discussed with Wagner the possibility to insert a loose red paper in the next edition of the journal “Zeitschrift für Physikalische Chemie”, stating: “The conference of the D.P.G in Zürich, from August 5th to 8th this year, will be of broader interest, because it will be discussed to what extent aspects of physical chemistry can be relevant for technology, and how the German Physical Society can absorb them.” The derivation can be made by you, or me, or another interested person. The other things I have at the moment are: the catalysts, the research on the radiation taking into account the “solid solution theory” and the …, the new sulfur derivatives / Le Bel / the stereoisomers, the essay by Duhem on “La chimie physique”, one about the technical condition of physical chemistry by Bancroft, Chohen’s research on tin, and then his note to Stannorie from ___ about the value of physical chemistry in the … and so forth, to which obviously more can be added. The derivation should be clearly defined as an addition, and it should be indicated that in the next edition of the Mitteilungen, 1901, there will be further details about this included. A side-aspect seems to be here: If the discontent with the present journal remains – and if in August it seems appropriate to the basis of members – subsequently the Zeitschrift für Physikalische Chemie could be created an organ, in the way that one of the three current volumes becomes an organ for the society and presumably contains discussions that are important for the journal, additions, and so forth.

Autograph letter signed, January 2, 1903, Charlottenburg:

I have now an offprint of Hartmann’s work, and include a copy with this letter. Would you kindly give me your advice, or opinion. Since the essay contains, as we already know, a … visible with difficulties. Whereupon I approached the author and asked him very generally for his active participation. He told me, however, that he has an eye problem and is unable to contribute in any way.

Now I think that in the interest of the edition and also of the author, it is important to go over the document. I would love to convene with you and discuss the points that need to be corrected. First
we two should work together and when in doubt contact Hartmann and then all three of us can think about “if” and “how” something should be corrected. In doing so, the approach of Glauck could serve us as a model, when he edited the works of … for the… This gives the opportunity to occasionally insert comments in the text and also in the notes, according to the particular case. I am convinced that this is of advantage for all, the author, the editor, and the reader.

**Autograph letter signed**, June 26, 1905, Berlin:

Dear Colleague.

On occasion of your inquiry I was reminded of a statement, Strecker made many years ago, about experiments in which NH₃ served as a catalyst. Maybe it does that as a base and then this case is useless for you, but perhaps it’s different.

If I remember correctly, then Huber used for the synthesis in glycocyamine only cyanamid and glycocoll as catalysts. Also ammonia works with lyanamid alone as catalyst.

Here are basically two reactions, and the first task would be to determine whether ammonia works as a base, and if NH₃ works as a base. If not you could try other experiments, first of all glycocol or cyatin.
The Research Library

Around 80 books, most bearing the ownership stamp or signature of Bredig, many with his notes inside them, showing his deep mathematical and scientific abilities.

Among the books:

Bredig, Georg, Anorganische Fermente, Verlag von Wilhelm Engelmann, Leipzig, 1901, his proof copy

Curie Marie, Traité de Radioactivité, tome I-II, Paris, Gauthier Villars, 1910

Arrhenius Svante, Die Chemie und das Moderne Leben, Leipzig, Akademische Verlagsgesellschaft m. b., 1922


Haber, Fritz, Thermodynamik technischer Gasreaktionen, munchen Druck und Verlag von Oldenbourg, Munchen and Berlin, 1905

Haber Fritz, Thermodynamik technischer Gasreaktionen, Berlin, R. Oldenbourg, 1905


Nerst Walther, Experimental and Theoretical Application of Thermodynamics to Chemistry. London, Archibald Constable & Co. LTD, 1907

9 books of Ostwald, including:

Ostwald, Wilhelm, Einfuhrung in die Farbenlehre, Leipzig, P. Reclam jun., 1919

Ostwald, Wilhelm, Der Werdegang einer Wissenschaft, Leipzig, Akademische Verlagsgesellschaft m. b. H, 1908

Planck Max, Vorlesungen uber die Theorie der Warmestrahlung, Leipzig, Johann Ambrosius Barth, 1906

Planck Max, Thermodynamik, Dritte auflage, Veit & Comp, 1911

van’t Hoff, Jacobus Henricus, Vorlesungen uber Therioetische und Physikalische Chemie, Zweiter, Dritter heft, Braunschweig, Friedrich Vieweg & Sohn, 1899

Van der Waals Johannes Diderik, Die Continuitat Gasformigen und Flussigen Zustandes, Theil 1, 2, Leipzig ohann Ambrosius Barth, 1899-1900

Zsigmondy, Richard, Kolloidschemie, Leipzig, Otto Spamer, 1912

Several by Bredig

More than 300 off-print and first run scientific pamphlets from the world of physical chemistry, many of them uncommon.
Among these:

More than 50 editions of Ostwald’s Klassiker, stretching decades.

Arrhenius, Svante, Theorien der Chemie, Akademische Verlagsgesellschaft m. b. H, 1909

Einstein, Albert, Geometrie und Erfahrung, Berlin, Julius Springer, 1921

Einstein, Albert, Tagesfragen aus den Gebieten der Naturwissenschaften und der Technik, Booklet 38, Braunschweig, Friedr. Vieweg & Sohn, 1920

Haber F., Neubestimmung des Ammoniakgleichgewichtes bei gewöhnlichem Druck, Karlsruhe, G. Braunschen, 1913

Ostwald Wilhelm, Prinzipien der Chemie, Leipzig, Akademische Verlagsgesellschaft m. b. H, 1907

Planck Max, Berichte der Deutschen Chemischen Gesellschaft, Berlin, 1912

Planck Max, Positivismus und Reale Aussenwelt, Leipzig, Akademische Verlagsgesellschaft m. b. H, 1931, 2 copies

Planck Max, Acht Vorlesungen Über Theoretische Physik, Leipzig, S. Hirzel, 1910

Planck Max, Das Weltbild der Neuen Physik, Leipzig, Johann Ambrosius Barth, 1929
“Bredig Und Mitarbeiter”

A rare collection of prints, notes, letters, showing the work of Bredig and his colleagues over decades.

Bredig diligently kept records of publications. He organized a series of binders, each containing 50-100 off-print and first run scientific pamphlets on chemistry and physical chemistry, along with letters on the subjects and other notes he made. These are extensive, with many rare prints stretching decades of his work in Germany, organized into 6 different sets.

These number in the many hundreds, perhaps thousands of pages and must be seen.


Bredig retained the printed publications of his students out of his laboratory. Dating from the 1890s through the 1920s. They are bound them into 4 large volumes of printed materials, combined with some letters and notes from him and others, most with his ownership stamp and some signed by the authors. Subjects are primarily related to chemistry and physical chemistry. Each contains perhaps 30 off-print pamphlets and other first run published pamphlets, labeled A-Z.

Many are signed by the authors.
Photographs, Many Signed, of the Dawn of Physical Chemistry, Showing the Dawn of Modern Chemistry Through the Eyes of Some of Its Founders

Over 100 photographs documenting the dawn of physical chemistry from Bredig’s vantage point at the center of it all, from the van’t Hoff’s lab in Amsterdam in 1894 through the creation of the first
physical chemistry laboratory in Leipzig, to Bredig’s own lab in Karslruhe. Many of the photographs are signed by multiple people, including some which feature entire laboratories of physical chemists, all of whom have signed or been identified. Of the more than 100 images, many are laboratory photos showing the chemists in action; and approximately 35 are signed.

The photos, many of which are oversized, include:

Photograph of van’t Hoff’s institute in Amsteraden, 1894;
Photograph of the scientists at the Amsterdam institute, including Bredig, Ernst Cohen, Dr. Rothmund;
Photograph of the scientists at the Chemical laboratory at the University in Heidelberg, 1906, signed by all.

Teachers and assistants at the Chemical laboratory at the University in Heidelberg, 1907, where Bredig was the first Physical Chemistry professor; Signed by all 12 members of the lab, including Bredig, Karl Mohr, Albert Fraenkel (who helped find the cause of bacterial pneumonia and was robbed of his license to practice by the Nazis);
International Chemical Reunion Utrecht, 1922, photograph of event organized by Ernst Cohen (later killed in holocaust), showing more than 50 chemical scientists;
Photograph of the opening of the first Physical Chemistry laboratory in Leipzig, signed by nearly all the many attendees, including the head of the lab, Wilhelm Ostwald, with Bredig seated next to him;

Photograph of the Leipzig institute from 1899, showing the same group;
Photograph of the Leipzig institute, showing the scientists drinking beer, 1898, signed by all.
Photograph of events at the first Physical Chemistry laboratory in Leipzig, including Christmas parties and scientists conducting experiments;
Photograph of Svante Arrhenius, imperial cabinet photograph, 1895, signed the year of his great report on climate change;
Photograph of Ernst Cohen, signed. Cohen would die in Auschwiz, but before, helped Bredig escape;

Photograph of Ostwald, signed by Ostwald, Arrhenius, van’t Hoff, Rothmund, and Abegg. This is signed by 3 Nobel Prize winners in Chemistry;
Photograph of Ostward meeting with Arrhenius, signed by both;
Photograph of the Stockholm office of Arrhenius, 1895;
Photograph of the Zurich office while Bredig was there, 1911
An Archive of Unpublished Letters From Nobel Prize Winner in Chemistry
Fritz Haber

*Letters from the experiments that led to his use of chlorine gas in early chemical weapons to his advice to an aspiring chemist on how to succeed*

Letters of Haber showing him attempting to understand the decomposition of HOCl to form chlorine gas. The “ClO3” anion (chlorate) which forms from the decomposition of HOCl is found in bleach, and was used a few years prior to treat drinking water to prevent disease. In 1915, Haber would become infamous for introducing chlorine-gas chemical weapons into WW1. The first shows him studying the equilibrium between water and oxygen to form hydrogen peroxide using their concentrations (“C”). Noteworthy in this document is the application of the van ’t Hoff equation \( E = \frac{RT}{2\ln(\ldots)} \). The second shows a related analysis of the decomposition of HOCl in acidic conditions (HCl = hydrochloric acid). Haber is investigating the production of ClO with time \( \frac{dC_{\text{ClO}}}{dt} \) in terms of the concentrations of reactants, and the rate at which their reactions proceed: \( k, k', k'' \). As HOCl decomposes to form HClO3, HClO3 further decomposes to form water and chlorine gas in relatively large amounts.

*Autograph letter signed*, January 18, 1900

Dear friend!

Do you remember what we discussed in Leipzig about the platinum potentials? In the meantime I have read your very beautiful work and continued pursuing my own projects further. Truly, nature is easier than phantasy. The platinum potentials in the presence of H2O2 and with platinized gold, where platinum is omitted as diffusion field, that’s what I see so far just with \( E = k \lg \frac{1}{CH2O2} \text{ – const.} \)

The oxygen concentration on the surface of platinum, that determines the potential, is therefore at equilibrium with H2O2. \( CH2O2 \cdot CO = k \cdot CH2O \cdot CO2 \) with a constant right side.
Autograph letter signed, Letter from January 28, 1900:

Dear Friend!

I am sure that the current status of my H2O2-studies will interest you. According to my research, as I already wrote to you, there is an equilibrium at a platinized golden electrode, according to $\text{CO} \cdot \text{CH}2\text{O}_2 = k \cdot \text{CH}2\text{O} \cdot \text{CO}_2$ which means in regard to the stability on the right side, that: $E = RT/2 \ln ... - \text{const.}$ This is true in the 2-times. According to this it is easily recognizable that every oxygen concentration on the electrode surface detracts a hydrogen peroxide concentration, (page 2) which therefore is in equilibrium, and then the size emerges immediately from the formula. In doing so, attention should be paid to the following: the four elements CO, CH2O2, CH2O, CO2 are not only linked by the specified relationship, but between CO and CO2 exists also the relationship of $O = O + O$.

This process is moving slowly compared to the other of $O + H2O2 \leftrightarrow H2O + O2$ so that the first one can't find that the equilibrium corresponding to the last one will be observed, even though the first one raises the ion concentration from 0 consistently, so that the later one constantly has to move from right to left in order to reach the equilibrium by releasing oxygen. (Page 3) We therefore simultaneously have catalyst and equilibrium or with other words, we observe a vivid reaction, but are always very close to a balance.

I also would kindly ask you for a fast response in regard to how Melville approximately dealt with the transformation of KCLO in KCLO3. Of course I will treat your information, if I find it convincing, as Melville’s/your intellectual property. I will now occupy myself with Foerster’s thesis (Glorastaise???). Many things about this are astonishing.

His proposal of $3\text{HOCl} + \text{Cl} = \text{ClO}_3 + 3\text{H} + 3\text{Cl}$ for example, is very curious, because here it is requested that with an alleged “oxidation of gloriones” with hypochlorous acids the ion concentration of gloriones rises. (page 4) Certainly $3\text{H} + ...$ is supposed to have a balancing effect and lower them again. But no matter how one formulates the speed of the real process, it must become a whole with growing glorione concentration. In the easiest case $d\text{Cclo}/dt = ...$ whereat
C(Cl) lifts the Cl ion concentration to the left. The only possibility is therefore to test the first reaction as an incredibly fast way to reach equilibrium, and to adapt the observed process to the second equation...

C3HOCl … / so that salyaun and gloriaun are always with under-ionian in equilibrium, while HCl and HOCl are not in balance, and we would then have the entire movement of the equilibrium.

A)  
B)

The equilibrium for B) is now measured and the glorgar of atmospheric pressure would follow. / K” = … / But this is the expression of the reaction HClO … / Now we know that B) is one of the reactions that is very fast and balanced. And thus we would have for A) and for B) a momentary volume that Foerster has discovered by observation. There would be many more similar things. But I don’t want to hear what you have already found out, before I inform myself on the status of the research.

Greetings, yours F. H.

Several letters of Fritz Haber and Chemist Kasimir Fajans to Max Bredig regarding potential employment of Max Bredig at the Kaiser Wilhelm Institute in Berlin. Fajans was a Polish American physical chemist of Polish-Jewish origin, a pioneer in the science of radioactivity and the discoverer of chemical element protactinium.

These letters are a mix of business and personal, instructing Bredig on how to interview for such a position. The tone is very familiar, good humored and he is going out of his way to help young Max. Such as “either you do exactly as I tell you, or you may go straight to hell. (or the devil may get you)…. I have informed him, that you can be a bit shy and awkward, since you grew up among professors, and that professors consider people in your situation in a transition from dilettante to a real person; in summary, I prepared him, that it will be necessary to drill through your skull to find a scientific and savory intellect. ….If you are willing to utter some words between your teeth in the
interview and don’t have one of those shy moments, where you drive me to desperation with your meticulous concealment of any thought.
An Archive of Hundreds of Letters from Many Scientists of the Era, Including Nobel Prize Winners

Mostly scientific and many on subjects for which they best known

Ehrlich on Diphtheria Research

Autograph letter signed, no date, on his chemical research into diphtheria and other subjects. In part: Allow me to send you some of my latest work, from which you will see, that I too have made an effort to work in the dark field… according to the modern forms of chemical opinion.

The point of departure of my observation is the fact, that for diphtheria poison is surely arce? static, which has since been confirmed by Mardsen in the same publication: that a longer treatment of strong cells the saturation point for antibodies remains constant, while the Pleiadene contained in the mass, drop considerably to less than half or even more.”Fajan called Pleiadene the Isotopes (Pleiadene is an ortho- and peri-fused polycyclic arene.)

Ernst Rutherford on radiation and radioactive decay

In early work, Rutherford discovered the concept of radioactive half-life, the radioactive element radon, and differentiated and named alpha and beta radiation. It is the basis for the Nobel Prize in Chemistry he was awarded in 1908 "for his investigations into the disintegration of the elements, and the chemistry of radioactive substances", for which he was the first Canadian and Oceanian Nobel laureate.

Ernst Rutherford, Typed letter signed, June 29, 1912, a remarkable letter describing an important moment in his work on radioactive decay. “I have received your letter asking me my opinion on the work and abilities of Dr. Fajans, who spent a year in my laboratory. It is a great pleasure to me to do so, for Dr. Fajans impressed me throughout as a young man of unusual ability and great promise. He spent a year in my laboratory; the first month was occupied in gaining an acquaintance with the practical methods of measuring radioactivity. I then suggested that he should investigate the abnormal behavior of the product radium C, which had been noted by Hahn.
This difficult problem was attacked by Fajans with great energy and skill and by an unusual combination of experiment and deduction, he was able to prove that radium C was transformed in two distinct ways. This result was of great importance for it was the first time that definite proof was obtained the atoms could break up in two distinct modes. I understand that Dr. Fajans is at present published an account of later work on the subject.

“Dr. Fajans has a very thorough and accurate knowledge of the subject of radioactivity and is a skilled and careful experimenter in that subject. He is a man of unusual originality and may be relied upon to do good work in the future.

“I cannot of course speak with the same authority of his investigations into other branches of physical chemistry, but I have heard some of my colleagues who are in a position give a definite opinion express a very high appreciation of his work in these fields.

“I consider Dr. Fajans one of the best research students I have had in my laboratory. He possesses in a marked degree those qualifications which are essential for a good teacher and investigator in a university. Dr. Fajans is a man of great energy and enthusiasm and I feel confident would prove an admirable and inspiring lecturer. I consider that any institution would be fortunate which was able to acquire his services.”

3 letters of Max Planck

3 letters of Max Planck, Nobel Prize winner, one being an Autograph letter signed, March 3, 1920, “On your esteemed letter of the 26th v. Chr. M. I would like to tell you first of all that the question of the procurement of foreign literature for the German universities currently as one of the most urgent matters are dealt with here. All scientific circles, academia, Libraries, institutes, scientific societies are busy.... The desirable goal of every university of owning a copy of any foreign journal can not be reached for the time being....”

Niels Bohr, Typed letter signed, June 22, 1931, Copenhagen:

Bohr recommends Werner Kuhn for the position as Professor at the University in Karlsruhe. The recommendation is based on his scientific knowledge, his ability to give lectures, and also his qualification as a teacher. In the last paragraph on page 2 he refers to the other candidates for this
position, that he doesn’t know them as well, but that he is convinced that Werner Kuhn would be the best choice.

Three autograph letters signed of Richard Zsigmondy, 1925 Nobel Prize in Chemistry

Autograph letter signed William Ramsay, 1904 Nobel Prize in Chemistry

Autograph letter signed Richard Abegg

Autograph letter signed Max Bodenstein

Autograph letter signed Walther Nernst, 1920 Nobel Prize in Chemistry

2 Autograph letters signed Wilhelm Ostwald

Document signed and 3 pages of manuscript notations by van der Waals

2 Autograph letter signed George de Hevesy, 1943 Nobel Prize in Chemistry

Autograph letter signed Arnold Sommerfield

Many, many more.